

Design and Fabrication of 5-DOF, 3D Printed Industrial Robotic Arm for Pick and Place Application

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2nd Semester 1445 / 2023-2024 GP 2

Abstract

This project focuses on the design and fabrication of a 5-DOF industrial robotic arm specifically engineered through 3D printing technology for pick and place applications. The project progresses through several key phases: designing the robotic arm, fabricating the components using additive manufacturing, and assembling the parts. Then implantation and testing the robotic arm.

Objectives

- Design the 5-DOF 3D-printed Industrial Robotic Arm.
- Fabricate the Robotic Arm Using Additive Manufacturing (3D Printing).
- Assemble the 5-DOF 3D-printed Industrial Robotic Arm.
- Implement and Test the 5-DOF 3D-printed Industrial Robotic Arm.
- Documentation of the Results.

Table 1. Mechanical Design Constrains .

Payload (estimated) (N)	2
Maximum Dimensions of 3D printer (mm)	220 x 220 x 250
Average Human Arm Size (mm)	660 – 760
Yield Strength (Pa)	5x10E7
End-Effector Selection	-

Fabrication



Figure 2. 3D printing machine & PLA Filament.

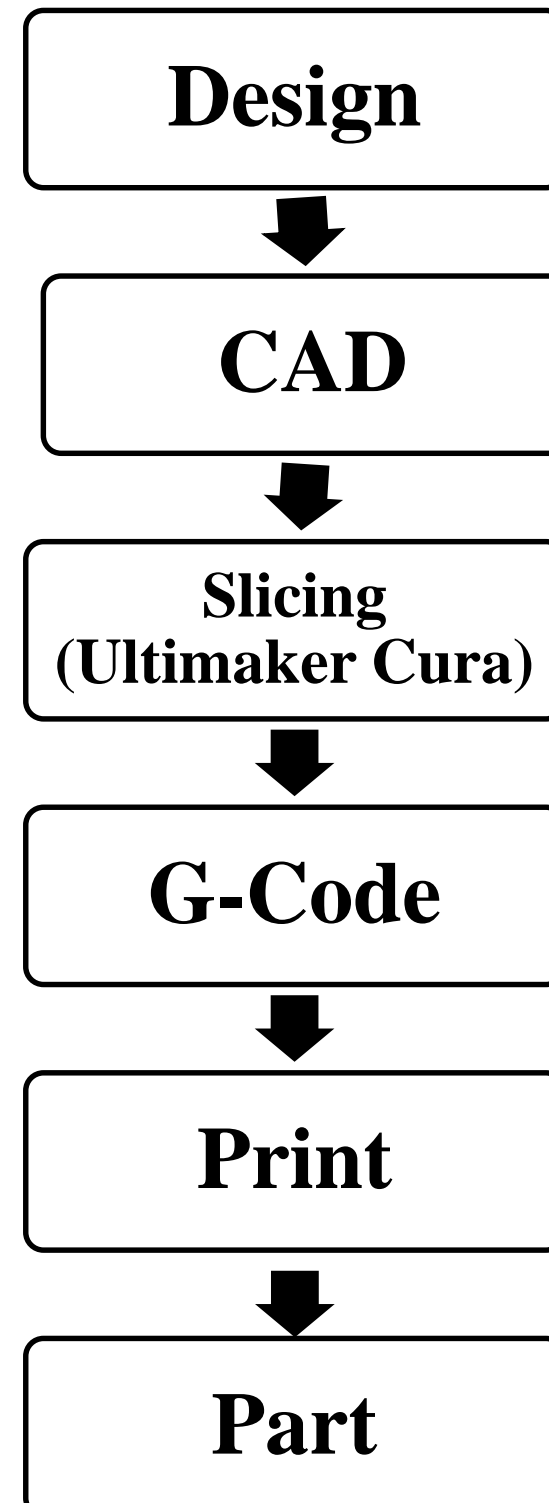


Figure 3. 3D printing Process.

Table 2. 3D printer Properties.

Build Volume	220 x 220 x 250
Nozzle Diameter (mm)	4
Filament Diameter (mm)	1.75
Print Speed (mm/s)	30 - 180

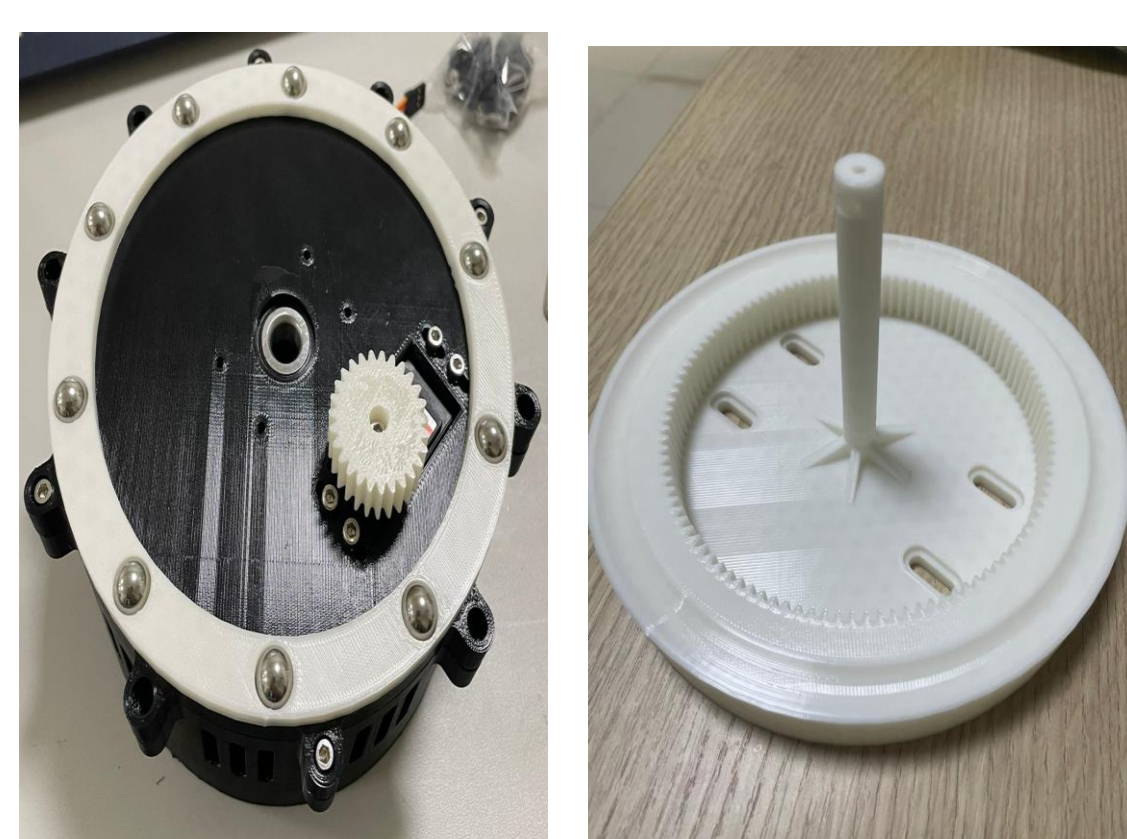


Figure 4. Some 3D printed Parts.

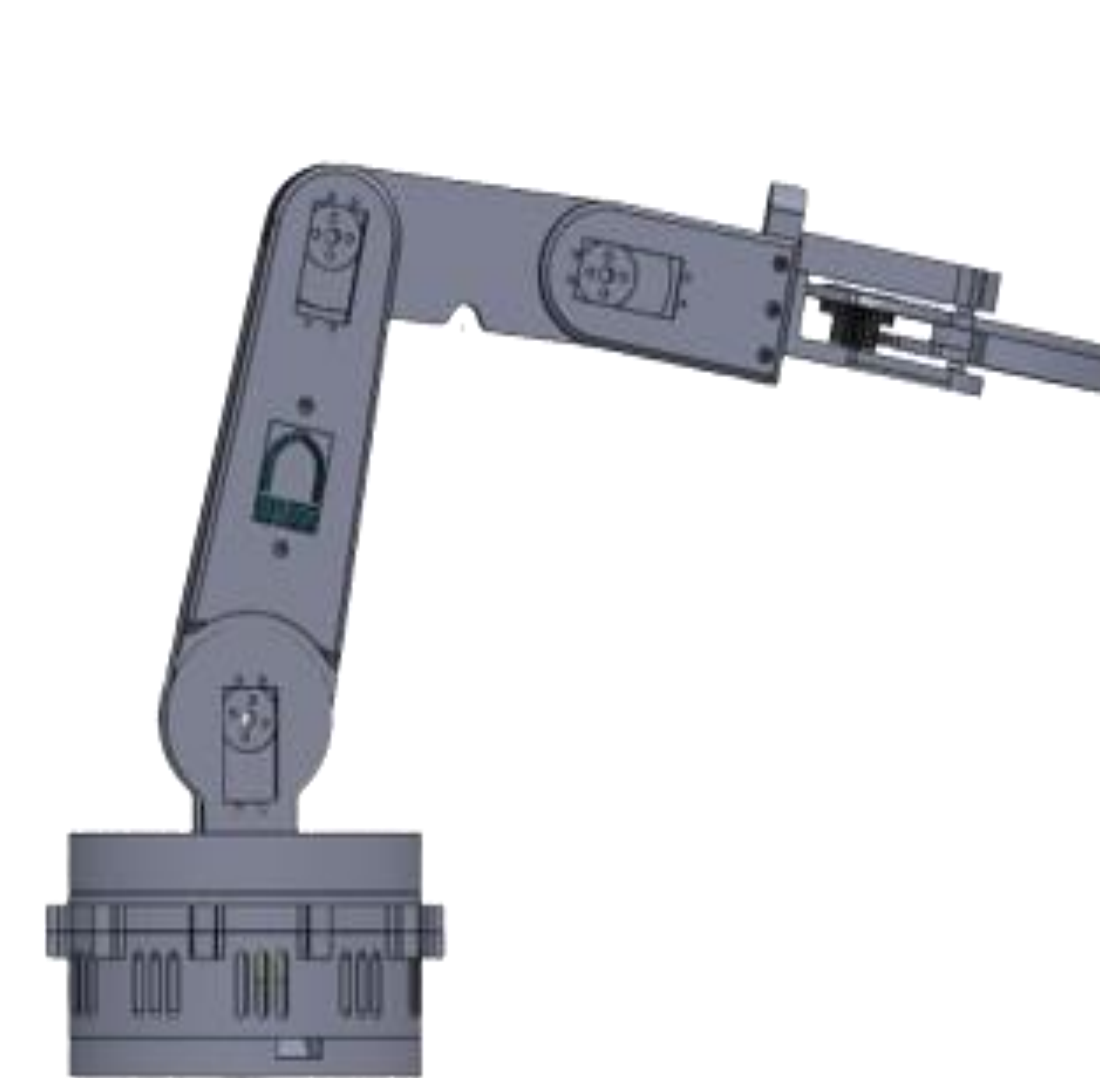


Figure 5. CAD of 5-DOF Robotic Arm.

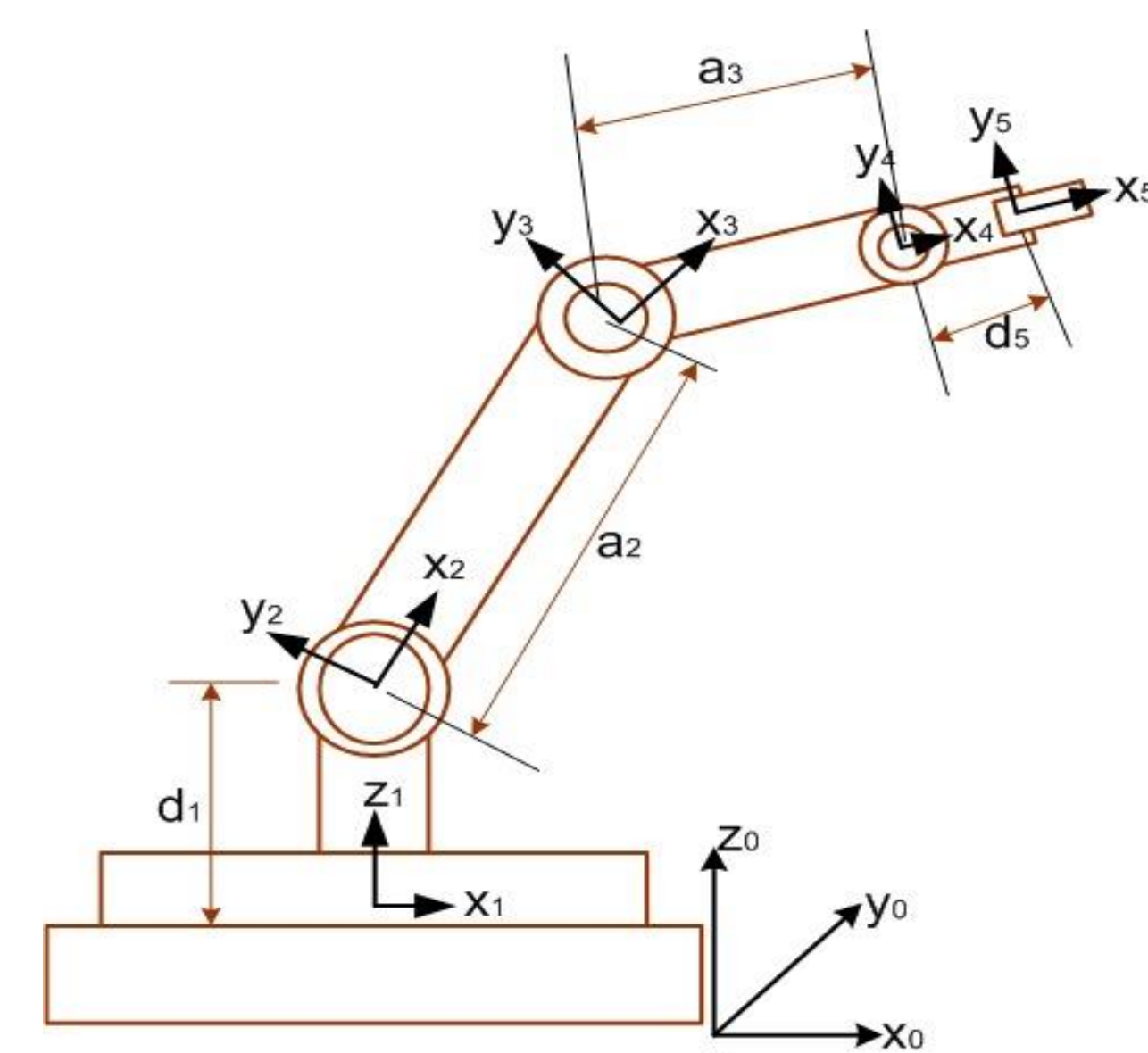


Figure 6. Robotic Arm Model

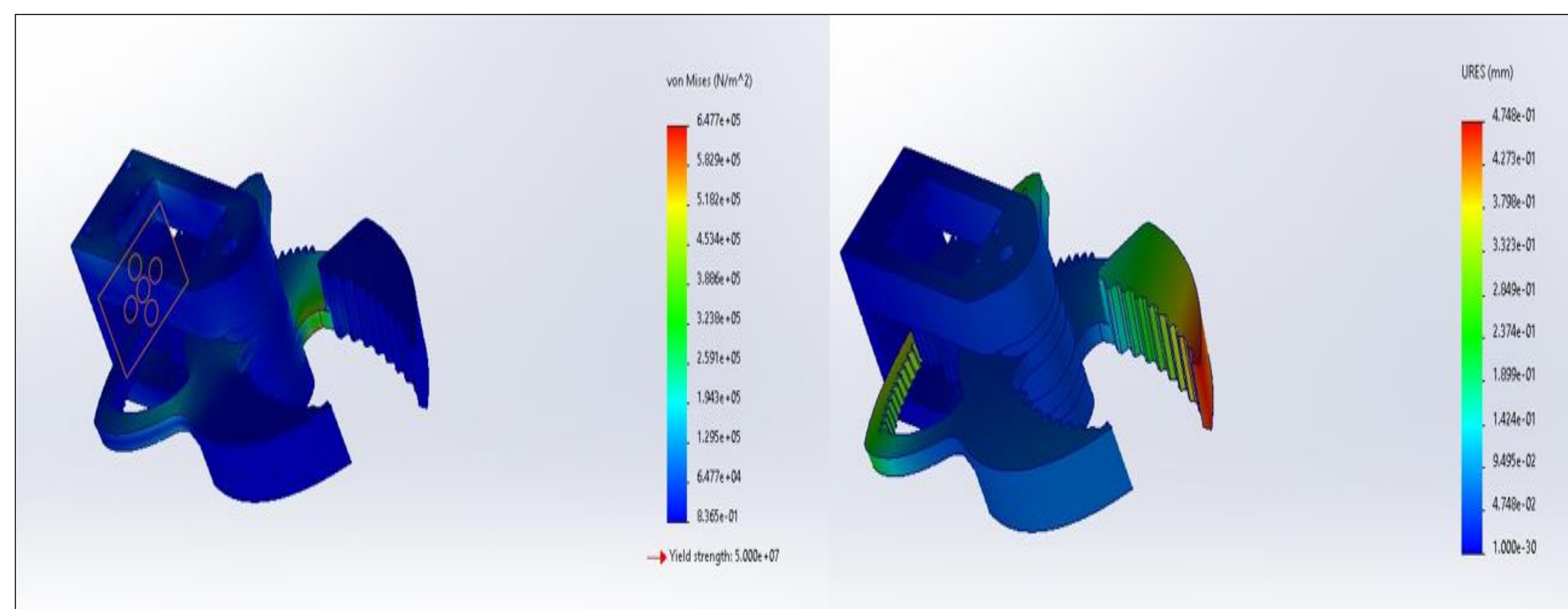


Figure 7. Static Simulation for the Gripper.



Servo Motor Type	Load (kg)	Angel (°)	Speed (sec/60°)	Torque (kg.cm)
Servo 360°	35	360	0.192	35.5
Servo 35kg	35	180	0.192	35
Servo 35kg	35	180	0.192	35
Servo 20kg	20	180	0.240	20
Servo 20kg	20	180	0.240	20
Servo 20kg	20	180	0.240	20

Figure 8. Servo Motors Properties.

Figure 1. Electrical Configuration of The Robot Wiring.

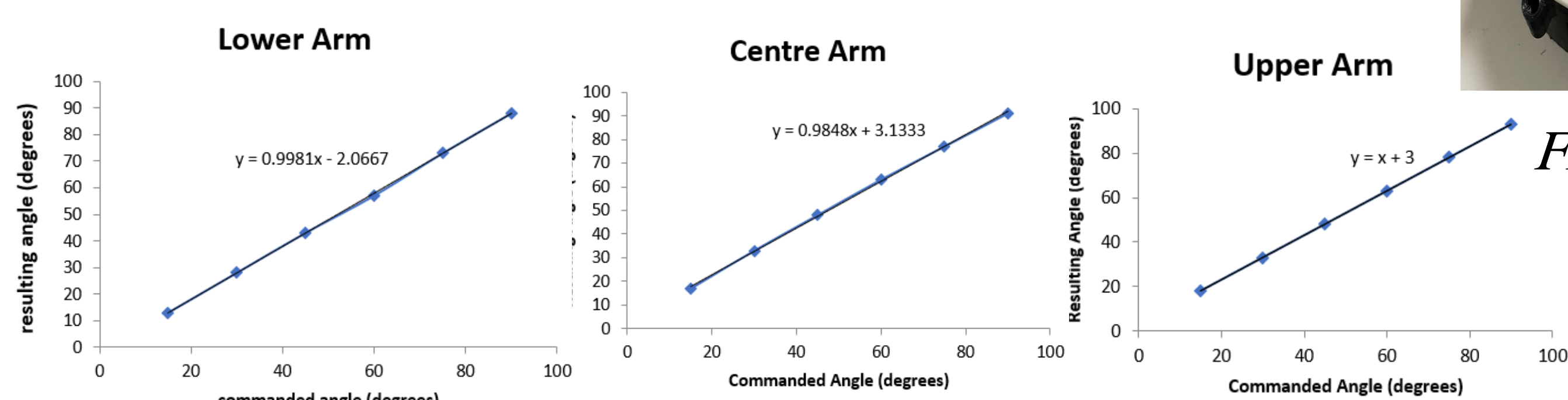
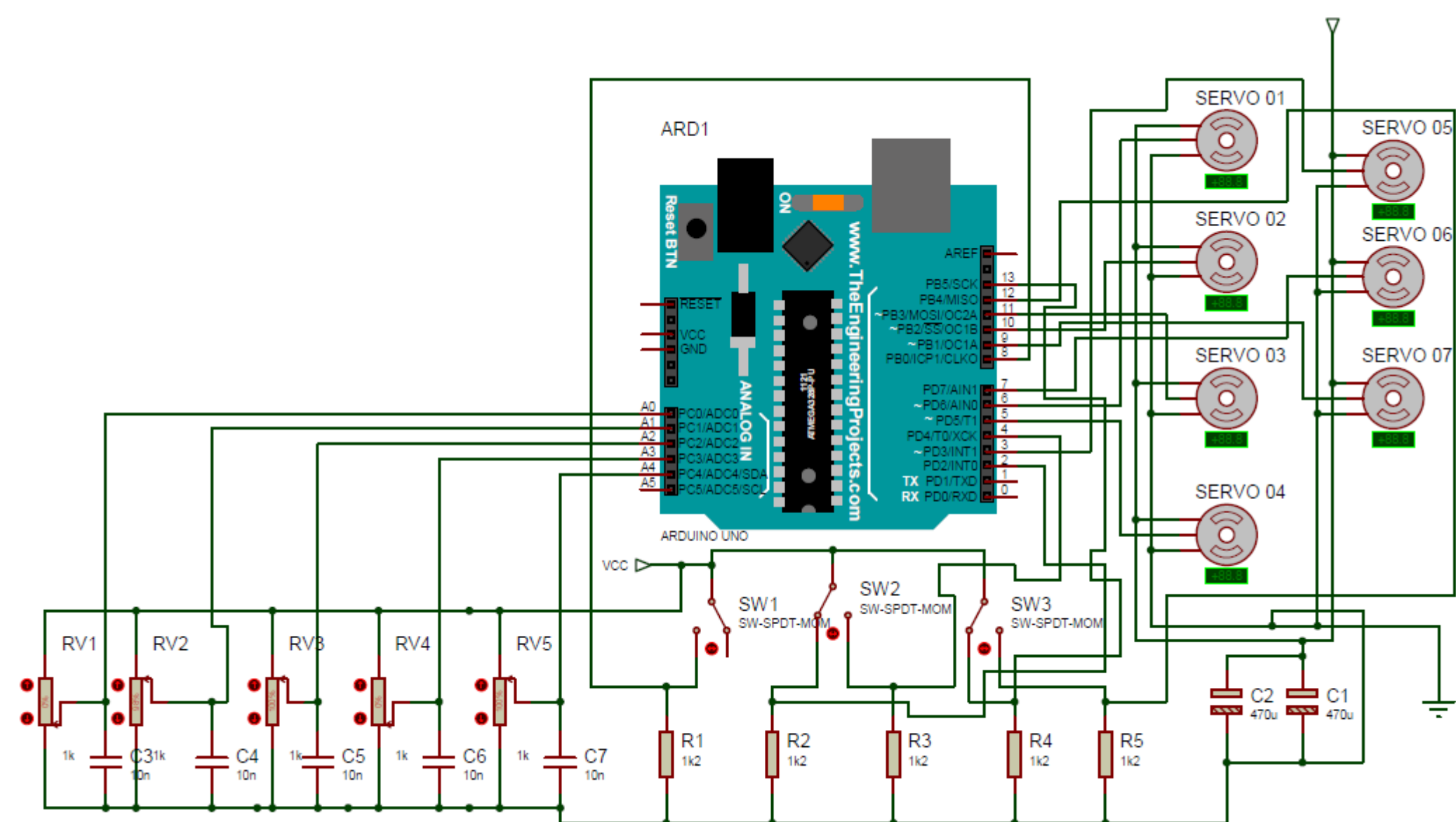


Figure 10: Accuracy Test

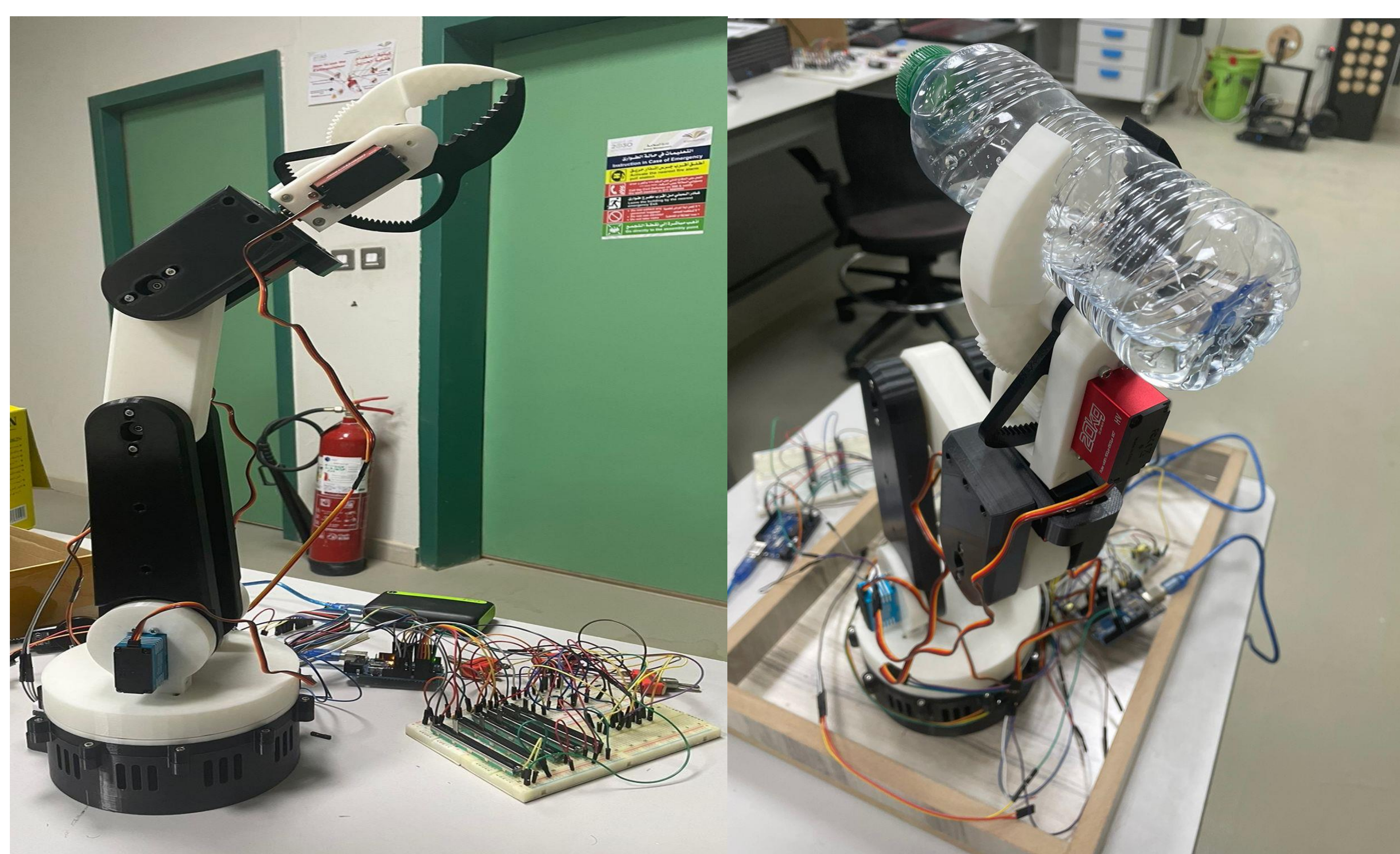


Figure 9. 5-DOF Robotic Arm 3D Printed Prototype.

Conclusion

Graduation project II Completed the mechanical & electrical design, fabrication using 3D printing and assembling & testing the 5-DOF robotic arm.